DOCUMENT RESUME

ED 299 446 CE 051 094

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TITLE Training Evaluation as an Integral Component of Training for Performance.
PUB DATE 87
NOTE 23p.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Course Evaluation; *Evaluation Criteria; *Evaluation Methods; *Industrial Training; *Inplant Programs; Job Training; Management Development; Models; Nuclear Power Plants; On the Job Training; Postsecondary Education; *Program Evaluation; Program Improvement; Staff Development

ABSTRACT

A training evaluation system should address four major areas: reaction, learning, behavior, and results. The training evaluation system at GPU Nuclear Corporation addresses each of these areas through practical approaches such as course and program evaluation. GPU's program evaluation instrument uses a Likert-type scale to assess task development, objectives, program outline, instruction, instructional material, student evaluation, training staff, and miscellaneous features. The objectives of course evaluation are to collect detailed, specific data from the trainees, the instructors, and a third-party evaluator and to collate the data into a useful narrative summary. A training evaluation system is seen as an important tool of improving plant performance by assessing trainee performance both in training and in the plant. (KC)

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TRAINING EVALUATION AS AN INTEGRAL COMPONENT OF TRAINING FOR PERFORMANCE

H.J. Lapp, Jr.

ABSTRACT

A training evaluation system should address four major areas: reaction, learning, behavior, and results. The training evaluation system at GPU Nuclear Corporation addresses each of these through practical approaches such as course and program evaluation. The major aspects of each practical component of this system are described along with an organizational structure to implement. A training evaluation system is an important tool of improving plant performance by assessing trainee performance both in training and in the plant.

INTRODUCTION

Utilities can be thought of as process cultures which are characterized as low risk and slow feedback organizations. For the nuclear power industry that changed in 1979 after the TMI-2 accident. Nuclear utilities were jettisoned through that culture into high level visability on a variety of issues. As a result of the accident, the industry now has long lists of auditors or checkers. Today these external auditors attempt to provide our evaluation function for us. In some areas this may work well, but in areas like training and plant performance, it may not. Training evaluation ia a critical link in the plant performance equation, hence the idea of Training for Performance. Internal training evaluation must become an integral component of nuclear utility training. Safe, reliable, and economic plant performance are the principle goals for our industry. To be successful, our industry must become more serious about generating an internal capability at training course or program evaluation.

CE051094

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Traditional audits, whether done by QA, INPO, or the NRC tend to identify our mistakes. These processes reflect a belief that finding our problems is someone else's responsibility. This article presents the conceptual ideas upon which a practical evaluation system is based and the organizational arrangement needed to implement. This evaluation system helps us as an industry to prevent training caused performance mistakes before they can occur.

Finally, if performance based training is to be the overall goal for training, then the term "performance" needs to be explained further. The use of the word "performance" does not mean successful only performance of trainees in a given training program. This is certainly desirable but is not the real reason why the training is happening. "Performance" in this case means performance on the job; which leads to successful plant performance. The real purpose of training is to improve job performance - Training for Performance. An evaluation system must reflect that reality.

TRAINING EVALUATION SCHEMES

The purpose of training evaluation is to provide data to training and line management so that intelligent, prudent, and economic decisions can be made about training courses and/or programs.[1] This process is accomplished by identifying the strengths and weaknesses of the training. No one evaluation instrument can provide all the valid data that we require.

P.R. Clark, CEO of GPU Nuclear Corporation in his talk in Lyon, France at the Human Performance Workshop stated, "... in nuclear activities, it is not the admitted lack of perfection but the inability or unwillingness to learn from experience that is intolerable."[2] Since evaluation is an important tool of capturing

experience, several evaluation schemes or processes exist at GPU Nuclear to identify our strengths and weaknesses. The following evaluation schemes are important tools in ensuring that we are training for performance:

- Program
- Course
- Instructor
- Trainee (while in training)
- Trainee (once back on the job)

Program Evaluation

The two most common labels used to describe training are training programs and training courses. These two labels describe training that differs primarily due to length. Training programs are usually large scale training efforts which we use to develop new personnel by certification or qualification to do specific jobs. Since each varies significantly in length, it is more practical to approach their evaluation with appropriately scaled processes. This ensures that our evaluation activities will remain manageable and economical. Some typical training programs include the Non-Licensed Operator and the Radiological Controls Technician training programs.

To better understand the complexity of a program, it may be helpful to briefly describe its anatomy. Many training programs are broken up into segments or phases such as classroom, laboratory/simulator, and OJT. The classroom may be further subdivided into fundamentals or systems. It is not unusual for these to be further broken into specific courses such as heat transfer, pump principles, rigging, or the RHR system.

Instructor involvement is another aspect about training programs which generally differs from individual courses. The conduct of our largest training program generally requires the coordination of several different instructors. This aspect can often complicate the evaluation but is an important facet that should be recognized and addressed where possible.

The continuity of a program is generally difficult to achieve when many instructors are assigned to teach. Program evaluation should be sensitive to this issue, and point out problems in this area when observed.

Since programs are generally made up of courses which are frequently grouped into segments or phases, it is important to evaluate how well the phases are tied together. Program evaluation should not only collect data about specific pieces of the training but also how well these are integrated together. I have found that in many training programs the phases are generally well designed, when viewed by themselves. However, frequent problems are found in how the phases link together or the instructors utilize the content taught in the earlier phase.

The logistics of evaluating such large blocks of training requires the evaluator to carefully determine the proper quantity and level of data to collect. If too detailed, then the evaluation process becomes unwieldly and may demand an unreasonable amount of resources to complete. Most of us are familiar with the INPO Self Evaluation Reports [3] (SER) and the resource requirements we needed to complete them. The SER is a form of program evaluation.

I have several concerns with the INPO SER process if it is used as a utility's program evaluation process as I have heard suggested.

First it's not very suitable for those programs that are not presently under the accreditation process such as General Employee Training Program. Second, implementation of the SER required an extremely large and costly resource commitment, particularly in manpower. And third, the SER process is an open process as opposed to forced choice. The criteria are shaped in open-ended terms which made it difficult for less than fully experienced evaluators to arrive at consistent conclusions. I base that conclusion on the last three years of industry experience. Many utilities had to resubmit their SER's to INPO before they were acceptable so a site visit could be scheduled. There are a variety of reasons that could be attributed to resubmissions, but I believe this format to be one of the more important reasons.

NUREG 1220, Training Review Criteria and Procedures,[4] has recently been released as the NRC's check on the INPO process. This process is also another example of a program evaluation instrument. NUREG 1220 appears to overcome my last concern about the accreditation process and SER format. NUREG 1220 evaluates each objective on a numerical scale of 1, 2, 3. These numerical criteria are defined in the context of the objective (see Figure 1).

The NRC expects that two evaluators can complete a 1220 evaluation in two to four days. If a program lasts up to a year, that means that the evaluators are seeing an extremely small part of the actual course. They would essentially be doing an evaluation of the training documents.

Figure 1: Example from NUREG 1220

Review Guidance

2.2 Are learning objectives derived from or related to the knowledge, skills, and abilities needed for successful job performance?

Scoring Guidance

For the three to six tasks selected for the review, score this question as a:

1. if learning objectives are not derived or related to the skills, knowledge, and abilities that enable the trainee to perform these tasks.

2. if learning objectives are derived from or related to the skills, knowledge, and abilities that enable the trainee to perform tasks:

    ° Selected for initial training,
    ° Related to emergency/abnormal operations

(the only exceptions being any skills/knowledge that are assumed to
be entry-level skills/knowledge).

3. if learning objectives are derived from or related to the skills, knowledge, and abilities that enable the trainee to perform all the tasks selected for this review (the only exception being any skills/knowledge that are assumed to be entry-level skills/knowledge).

I am leary of paper drill exercises. The reality of the actual training is normally quite different from that cryptically described in the training documents. I can't overstate the fact that Training for Performance is our goal. To achieve maximum validity, evaluations should be done in the arena where performance occurs: in the classroom, in the simulator or lab, and after qualification on the job. The program evaluation instrument that is a part of our system accomplishes this since it directs the evaluator to follow the entire teaching cycle of the program. The evaluator monitors the effectiveness of the training through a reasonable number of classes through all phases. This includes going on shift to observe trainees during OJT. Additionally, it can also be done by one person!

The program evaluation instrument[5] which I have designed evaluates these long qualification oriented training programs. It examines each program in eight areas (see Figure 2). After initial experience, the instrument was revised and now includes some objectives/criteria of the accreditation process. One of the advantages of our evaluation instrument format is the use of the Likert scale (see Figure 3). Many questions are framed in a forced selection format. These are generally followed by a rating question which rates the overall quality as seen by the evaluator. An opportunity is generally provided so the evaluator can follow up with narrative comments if desired.

Figure 2: Program Evaluation Instrument Major Categories

I. Task Development
II. Objectives
III. Program Outline
IV. Instruction
V. Instructional Material
VI. Student Evaluation
VII. Training Staff
VIII. Miscellaneous

Figure 3: Typical Page from Program Evaluation Instrument

IV. [redacted]:

To complete this section, approximately ten percent of all lessons should be observed by the evaluator(s). A variety of instructional settings should be chosen if appropriate.

1. Are the classroom activities clearly related to each other and the lesson? Explain the basis for your conclusion and cite examples.

Always	Frequently	Sometimes	Infrequently	Never
5	4	3	2	1

2. Is the subject matter arranged and taught in an orderly sequence? Explain the basis for your conclusion.

3. Are the instructional methods* (demonstrations, reading assignments, labs, shop work, simulator) clearly related to the content being taught? Explain the basis for your conclusion and cite examples.

Always	Frequently	Sometimes	Infrequently	Never
5	4	3	2	1

4. Is the content of the program understandable to the student as exhibited by student feedback forms? Explain the basis for your conclusion.

Always	Frequently	Sometimes	Infrequently	Never
5	4	3	2	1

This instrument is formatted to simplify the creation of the evaluation report. The report is written as the evaluation instrument is being completed. Experience has found this aspect a real plus in reducing administrative resources needed to conduct a major program evaluation. Additionally, it standardizes the evaluation reports format from one evaluation to another.

At GPU Nuclear, the major focus of our efforts over the last two years has been oriented towards obtaining accreditation for our last 15 major training programs. The major part of this work was in the analysis and design phases of TSD which left little time for program evaluation.[6] Since we see the value of program evaluation, we are now placing considerable emphasis on more formal evaluations.

Course Evaluation

Many of our large training programs run six months or more on average. These programs are made up of many small courses as already described. What does one do when problems emerge in only one or two courses within a long training program or in a very short program like General Employee Training?

As previously mentioned, the program evaluation instrument is big picture oriented and wasn't designed to collect detailed data. To overcome this limitation, a course evaluation process was designed.[7] Course evaluation should achieve several objectives: 1) collect detailed-specific data, 2) obtain maximum input from involved participants, and 3) collate data into a narrative summary for quick disposition.

For course evaluation, whether for existing-mature courses or for new ones just being piloted, it's important to get as many independent points of view as possible. The trainees themselves have a unique vantage perspective. But the same can be said of the instructor(s). Many excellent instructors have complained that evaluation activities typically ignores their insights. Some even feel "ganged up on" so to speak, since we work in a highly regulated industry. The course evaluation process being described here mandates that the instructors have a formal input.

The major players in course evaluation are: the trainees, the instructor(s), and a third party individual called the course evaluator. To standardize the process from application to application, a series of forms exist to keep the focus of each activity on target. The course evaluator and one or more of the instructors review the major tests after administration. It is suggested that this review be done independently. Finally, the course evaluator pulls everything together into a narrative summary report.

This summary highlights the major strengths that were observed. It also identifies the most significant areas of concern and who made the identification. This last aspect is important to add to the validity and/or comprehensiveness of the finding. The lead instructor or supervisor has an opportunity to review the narrative summary before a face to face meeting is held. This step is very conducive to generating trust and rapport. It does not, as some might think, lead to compromise. In fact, that is the process INPO utilizes in finalizing its accreditation report after its site visit. In our process, if no serious disagreements exist, then a meeting is scheduled.

This meeting should be attended by the evaluator, instructor(s), the supervisor, and senior training manager. At this time, the issues are discussed. First the strengths of the course are reviewed then the concerns. Not all sited concerns will result in follow-up actions. Much depends on the severity of the concern and how frequently it was cited. Mutual agreement is sought to strengthen the commitment to the follow-up effort.

Follow-up actions are planned for those concerns that are accepted in this review meeting. These are classified into two categories: those needing correction before the course is retaught and those that can be addressed long term. Accountabilities are assigned to individuals to accomplish these actions (the individuals who have the capability to complete these revisions are generally the ones attending this meeting). The process is problem solving focused. Both the evaluator and the lead instructor or supervisor make a joint presentation to the senior training manager. This provides them with an opportunity to show off the quality of the course by providing an objective picture of the course's current status.

To date, nearly twelve course evaluations have been completed, several evaluated newly developed courses taught for the first time. The attitude towards course evaluations by many of our instructors and supervisors is changing as a result of the methods I've described particularly getting them involved. That is something I didn't expect but am very grateful for.

In our course evaluation experience, several interesting findings have been identified. One important finding deals with theory. In our industry, it appears that in many cases, we often provide <u>too much</u> theory for the practical aspects being taught. In several

evaluations we've completed, the trainees cited this repeatedly. And this was often independently noted by the course evaluator. It became difficult for learners to see the forest for the trees. In another area, findings pointed out insufficient opportunity to practice practical skills or tasks. Sequencing the material was taught in was another rather common finding identified. More practical suggestions were found via trainee and course evaluator comments or reactions on how to correct sequence problems. After all, our instructors are subject matter experts, and it's difficult for them to sense the impact one sequence can have over another on learning effectiveness. But trainees and course evaluators can. In retrospect, most instructors agreed to be more sensitive to course-content sequence.

Trainee Evaluation (while in training)

This is an important area in the evaluation process. Most utility training organizations expend more energy in this area than any other. Our own work at GPU Nuclear is strongly oriented towards evaluating group paced training. I hope that we will be able to shift towards diagnostic assessment as the individual enters training. That way he or she will only receive training in areas when a true need exists. This does not have to be done by expensive computer based training. It can be done economically with more traditional approaches.

Trainee Evaluation (once back on the job)

This area has been an especially fruitful area of pursuit for us. With the finalization of our TSD process, we saw this as an important evaluation activity.[8] In the past year, the Educational

Development Section (EDS) of the Training and Education Department has begun playing a more active role in this kind of evaluation.

In 1986 the Oyster Creek Operator Training Manager requested that EDS do the post training evaluations (as they are sometimes called) for one of his recently completed licensed operator training programs. The trainees had already been on shift for about six months after qualification. The primary reason for our assistance was to improve the objectivity of the collected data. The first attempt by Operator Training at getting the data was made by mailing a questionnaire to the participants and their supervisors. Returns were difficult to get, and the information collected was of little value. The former trainees and their supervisors appeared to be uncomfortable with filling out perhaps "another form." The Operator Training Manager thought in person interviews would likely be more useful. He was uncomfortable with having his instructors ask former clients, so to speak, how the program worked in a face-to-face interaction. In essence, the instructor would likely feel he was asking the trainees to now rate him personally.

EDS conducted the interviews anonymously using a series of questions in the evaluation procedure. The operators were a little nervous at first, but the Educational Development Coordinator or myself were careful to stress the purpose of the evaluation. The purpose wasn't to evaluate the former trainee since they had been so stringently evaluated during their training. To the contrary, it was their turn to help evaluate their learning experience. In addition, to minimize the threat, they were told they were not required to answer questions they were uncomfortable with. We were pleasantly surprised that no one refused to answer any of our questions. We used the interview questions from the procedure.

They willingly answered each question even one which asked them if they had made mistakes back on the job. To set the record straight, we are proud of all our training programs and our instructors. However, we learned a great deal about the program and identified about six key areas where it could be enhanced.

In one area, several ex-trainees told us they had a great deal of difficulty absorbing or retaining all the system knowledge which was taught in one continuous block. We asked them to provide suggestions. The reply we got was to integrate OJT into the systems phase. This recommendation was readily accepted by the Oyster Creek Operator Training Section.

Instructor Evaluation

One other important aspect of our evaluation efforts is instructor evaluation.[9] This evaluation area has been in place for many years now and is working quite well. Each instructor experiences several evaluations each year. Most of these are by his or her supervision to include section manager and manager of plant training. These primarily focus on technical content evaluations with secondary emphasis on the quality of the classroom instructional skills.

EDS performs one annual evaluation of each instructor. The primary focus of this evaluation is on the instructional skills. Lately the focus is shifting from what was almost a singular emphasis on teaching skills towards a balance between teaching skills and curriculum development. This latter area is exhibited through behavioral learning objectives and teaching materials such as lesson plan and trainee texts. Annually EDS evaluates all completed

instructor evaluations to identify the overall strengths and weaknesses of our instructors. Two of these analyses have been with good results. The identified areas of difficulty are relatively minor. In our latest analysis, we have seen generic weaknesses in the use of audio-visual media and in application of effective questioning techniques. Two advanced instructor training modules are under development as a result of identifying these needs through evaluation.

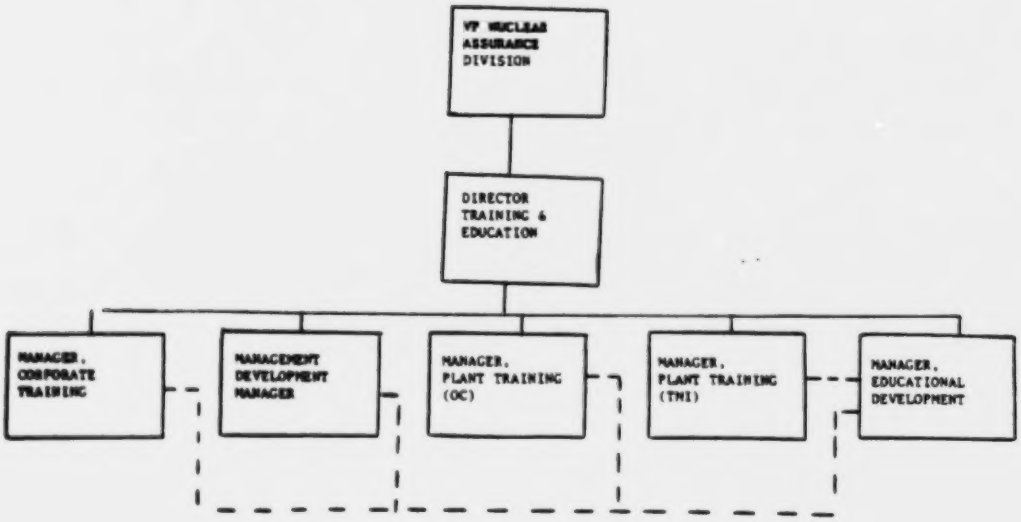
ORGANIZATION

If your plant has been through the accreditation process, you have developed and documented your systematic approach to training. It's effectiveness is highly dependent on your organization and how accountabilities are balanced. At GPU Nuclear, we have evolved to a team approach to training program development: subject matter expert, instructor, and instructional technologists.

Special attention is also being placed on knowledgeable but reasonably objective evaluations being done to support the department efforts.

To accomplish this, the Director of Training and Education Department (TED) established EDS. As our development efforts shift from TSD's front-end analysis phase to evaluation, EDS is continuing to play an active role. Figure 4 shows the TED's organization. I have added the dotted lines from EDS to the other managers to show how I perceive the emerging operational philosophy. EDS is a small, but dynamic, department resource with three (3) Educational Development Coordinators, one (1) Audio Visual Specialist (who operates our video tape studio), a Secretary, and the Manager.

Figure 4: Organization of GPU Nuclear's T&E Department



The manager/coordinators are training-learning specialists who posses advanced degrees. Three were former educators with both secondary and some college teaching experience. In addition, three have military training experience. To balance the educational perspective with practical utility experience, one coordinator has over 30 years with the utility. He was one of the original Oyster Creek startup staff whose nuclear experience predates 1967.

Over the past two years, I have made a serious effort to further develop and enhance their training development and evaluation competencies. I achieved this by coaching sessions and OJT which closely parallels apprenticeship.

This small cadre of training specialists supports approximately 80 instructional staff located at three training sites and supports training development and evaluation efforts for corporate clients. Since our resources are quite small, we have sought ways to increase the span of our reach. A module was recently developed on course evaluation which was taught to departmental instructors. We have used instructors/supervisors as course evaluators. The educational development coordinator coaches them through the process as it is done after taking the module mentioned above.

THEORY

Evaluation has always been the soft underbelly of the educational as well as the industrial training function. There are no shortage of opinions and concepts on what it is. But training staff generally dread being assigned to do evaluations. I believe this is principally due to a lack of tangible-objective mechanisms or processes.

In the early 1960's, Kirkpatrick, [10] one of the early thinkers on industrial training evaluation, developed an evaluation model. Almost all other models available today are based on his original plan. The Kirkpatrick evaluation model has four major components: 1) reaction, 2) learning, 3) behavior, and 4) results.

Step 1: Reaction

Reaction is based on the premise that adults are knowledgeable and experienced. They generally have important things to say. Whenever possible, an evaluation system should tap into this valuable resource. In our course evaluation process, we have reaction forms

for the trainees, the instructor(s), and the course evaluator (This process of soliciting reactions carries over to interviewing the former trainees and their supervisors four to six months after qualification in our model). Reaction evaluations are relatively easy to do which is likely why it is so popular. When reaction type evaluation constitutes the bulk of the evaluation system, there are tendencies to draw conclusions which are based on assumptions. To prevent arriving at questionable conclusions, evaluation must be based on other criteria as well such as learning. It isn't unheard of that training courses or programs have been cancelled or underwent drastic revision based on one negative comment from a senior management person alone. From the other extreme, there have been training courses which have received strong positive reactions which only entertained. These courses would have been dramatically changed if other data had been available. Neither of these extremes are desirable which motivates us to evaluate on other levels as well.

Step 2: Learning

Learning is not guaranteed just on the basis that a program has received a favorable reaction. Learning in this context implies retention of the facts, principles, and skills that were taught and understood by the trainees. There are five (5) guidelines that Kirkpatrick recommends be observed for measuring the amount of learning.

- Learning should be measured quantitatively.
- Where possible, pre and post tests should be used.
- Assessment must be based on behavioral learning objectives.
- Where possible, a control group should be evaluated and compared to the group that had received the training.
- Where possible, the results should be analyzed with statistical procedures for correlation and confidence verification for learning.

The principal methods which implement this guidance are generally used in the nuclear power industry: classroom demonstration and performance as well as pencil and paper tests.

Step 3: Behavior

Knowing a particular principle or possessing a skill does not guarantee that these will be used out on the job. Over the last three years, numerous articles have been written in training journals about the problem of learning transfer to the workplace environment. Perhaps that is one of the biggest challenges that remains to be solved for many nuclear utility training programs. Many millions of dollars have been spent designing the finest training programs with excellent training materials, facilities, and instructors only to find that trained or qualified people do not perform back on the job (in some cases, they are able to but prevented from performing for other environmental constraints).

Kirkpatrick's evaluation system provides five (5) guidelines that should be considered when evaluating behavior. They are:

- A systematic appraisal should be made of on-the-job performance on a before and after basis.
- The appraisal of performance should be made by one or more of the following groups (the more the better):
  - The person receiving the training
  - The person's supervisor
  - The person's subordinates
  - The person's peers or other people thoroughly familiar with his or her performance
- A statistical analysis should be made to compare performance before and after to relate changes to the training program.*

- The post-training appraisal should be made three months or more after the training so that trainees have an opportunity to put into practice what they have learned. Subsequent appraisals may add to the validity of the study.

- A control group (not receiving the training) should be used.*

The standard items are not now common to our industry. They are areas which should receive future consideration if additional improvements are going to be made.

Step 4: Results

What is the purpose of the training course or program? Is it to obtain licenses? Produce a specific number of qualified individuals for a particular job position? These have been some of the traditional measures of the results for some of our nuclear industry training programs. I can personally remember several years ago working with a very practical and hard nosed training manager. Our discussion centered on identifying the licensed operator training program results. The discussion covered considerable territory. Shortly after that, he received the pass/fail results from his plant's last set of NRC exams. A majority of his operators had failed their exams. This same scenario repeated itself with the next group of candidates. That hard nosed and practical manager was very much beside himself. He knew his job was on the line. If the training department couldn't obtain licenses, then there wasn't much purpose for it as far as senior plant management were concerned. No one knew this fact of life better than that training manager.

However, to succeed in the face of our new industry challenges, we must establish better goals and objectives for our training courses and programs than just the number of licenses we obtain. We must

look for better measures that reach out into the real environment of the plant. For mechanics, the number of rework tickets and the time it takes to complete routine jobs are examples that may be considered. The Utility Nuclear Power Oversight Committee (UNPOC)[11] has just been organized. One of its prime objectives is to improve the operational performance of nuclear power facilities. One of their primary goals is stated as a question. "How can the nuclear utilities accelerate the achievement of exemplary operational performance by all U.S. nuclear electric generating units?"

Initially ten (10) areas have been identified by UNPOC as prime candidates for plant performance. Training organizations should start with these and expand them while looking for other more applicable results oriented indicators for their training evaluations. In the meantime, training organizations should aggressively evaluate in terms of reaction, learning, and behavior.

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